site. The soils that compose this complex exhibit low water capacity and are used for pasture and wildlife habitat. The Veldkamp-Nederland very cobbly sandy loams are found at the extreme northwestern area of the site. Rock fragments comprise approximately 35 to 75% of this complex. It is primarily used for pasture and wildlife habitat. Soil at the extreme northeastern boundary of the site is known as the Valmont clay loam and is considered to be a "high potential cropland," requiring only irrigation to support agricultural activities. The Valmont is found on slopes ranging from 0 to 3%. It exhibits moderate water capacity and a slight erosion hazard if overgrazed. It is used primarily for crop growth, pasture, and sometimes for community development (U.S. Department of Agriculture, Soil Survey of the Golden Area, Colorado, Soil Conservation Service, 1980). Grazing does not occur within site boundaries, but does occur in some adjacent off-site locations.

Soil samples were taken from the NWTC and analyzed from late 1993 through 1995. The objective of the 1993 sampling program was to define the uncontaminated characteristics of site soil prior to the construction of a leach field. The soils were analyzed for VOCs, petroleum hydrocarbons, PCBs, and radionuclides. Analytical results indicated that detectable quantities did not exceed State of Colorado regulatory limits and were representative of environmental background concentrations (Soil Sampling Program National Wind Technology Center, 1993).

Results of a 1994 geotechnical investigation for facility expansion indicated that the on-site soils are suitable for supporting structures that included new site buildings and turbine foundations. However, foundations could be at risk of heaving caused by wetting and subsequent swelling of the clay portion of the underlying soils (Soil and Foundation Investigation, Expansion – Phase 1, NWTC, 1994).

Additional samples were subsequently taken in 1994 and analyzed in order to develop a more thorough baseline assessment of site soils. The analytical results for the majority of samples were below method detection limits and, therefore, below regulatory thresholds (Report for Reconnaissance Sampling of Soil at NWTC, 1994).

Geotechnical borings were taken and percolation tests were conducted in 1995 to determine subsurface conditions at the site in preparation for construction. The results indicated that subsurface soils at the site exhibited variable swell potentials that could be compensated for by using specified engineering excavation and construction techniques for foundations (Subsurface Investigation and Engineering Analysis Report NREL NWTC Phase II CDE, 1995).

3.8 BIOLOGICAL RESOURCES

The biological resources of the NWTC are broken down into vegetation, wetlands, rare plant species, and wildlife components. The following subsections detail these resources for the NWTC site. This evaluation primarily relies upon previous reporting and fieldwork by other consultants, both for the NWTC site, and on the adjacent RFETS. An extensive annual survey process provides extensive species lists for the NWTC, RFETS, and surrounding areas (USDOE, RFETS, Annual Vegetation Report and Annual Wildlife Survey Reports).

3.8.1 Vegetation

Vegetation types within the NWTC include grasslands, shrublands, ponderosa pine woodlands, and wetlands. Table 3-6 lists the vegetation types and acreage covered. Figure 3-4 presents a vegetation map for the project site. Wetlands are a special type of habitat that are regulated by the United States Army Corps of Engineers (USACE) and the EPA, and are discussed in the wetlands subsection.

Table 3-6. Vegetation Types Occurring at the NWTC, Golden, Colorado

Vegetation Type	Area (acres)
Grassland	267
Shrubland	1
Ponderosa Pine Woodlands	4
Wetlands/Riparian	6
Disturbed Lands	27
Total	**305**

Grasslands

Grasslands make up the majority of the land area (267 acres) at NWTC and comprise 88% of the total land area (see Table 3-6). These grasslands are classified as mixed-grass prairie (Plantae, 2000). As its name implies, mixed-grass prairie communities are comprised of a combination of plant species typically found in tallgrass and short-grass prairie plant communities, as well as several intermediate grass species. At NWTC, grass species important to the mixed-grass prairie plant community include big bluestem (*Andropogon gerardii*), little bluestem (*Schizachyrium scoparium*), prairie dropseed (*Sporobolus heterolepis*), blue grama (*Chondrosum gracile*), buffalograss (*Buchloë dactyloides*), needle grasses (*Stipa spp.*), wheatgrasses (*Pascopyrum, Agropyron, Elytrigia,* and *Elymus spp.*), and bluegrasses (*Poa spp.*) (Plantae, 2000).

An example of a xeric tallgrass prairie natural community (*Andropogon gerardii – Schizachyrium scoparium*) does occur on the NWTC site in areas defined as mesic mixed grassland in an isolated area in the southwest corner of the site between Rows 1 and 2 (see Figure 3-4). The Colorado Natural Heritage Program defines this community as “rare/imperiled.” NREL has placed this area in a formal Conservation Management Area to avoid and/or minimize impacts on this community from site operations.

Shrublands

Shrublands occur at one location and are a small (1.09 acres) (see Table 3-6) component of the NWTC’s vegetative communities, comprising less than 1% of the total land area. Shrubs found at this location include chokecherry (*Padus virginiana*), sand cherry (*Cerasus pumila* ssp. *besseyi*), wild plum (*Prunus americana*), serviceberry (*Amelanchier utahensis*), skunkbush (*Rhus aromatica* var. *trilobata*), hawthorn (*Crataegus erythropoda*), waxcurrant (*Ribes cereum*), Wood’s rose (*Rosa woodsii*), and prairie rose (*Rosa arkansana*) (Plantae, 2000). A diverse array of forbs and grasses also occur at this location.

GS-1

PE-4

GS-2

RF-2

RF-1

PE-1

PE-2

PE-3

EXISTING
ROCK CREEK RESERVE

Figure 3-4
Vegetation Map

N

Plant Community Legend

- Ephemeral Drainages
- Seasonal Pond
- Ponderosa Pine Woodland
- Upland Shrubland
- Xeric Mixed Grassland
- Mesic Mixed Grassland ✳
- Disturbed/Grassland Restoration Area
- Disturbed Areas/Roads/Structures

✳ Includes Tallgrass Prairie Species

Wetland Legend

Palustrine Emergent Wetlands

PE-1
PE-2
PE-3
PE-4 (Swale)

Groundwater Seep Wetlands

GS-1
GS-2

Riparian Fringe Wetlands (Average of 2' width along bank of ephemeral drainage)

RF-1
RF-2

0 100 200 300 400 500
SCALE IN FEET

BASE MAP SOURCE: NREL, 2001
FILE NAME: VEGETATION NEW.dwg
DATE: 5/09/02

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Pine Woodlands

One ponderosa pine (*Pinus ponderosa*) woodland occurs at NWTC. This woodland community (4.30 acres) (see Table 3-6) comprises 1.5% of the total land area. The understory of this community is composed of a mixture of shrubs, grassland and foothills plant species (Plantae, 2000).

Noxious Weeds

Within each of the plant communities previously described, noxious weeds also occur. Invasive species, including noxious weeds, are regulated by the Colorado Weed Control Act (Title 35, Article 5.5). On federal lands, noxious weeds are regulated by Executive Order 13112 "Invasive Species" (February 3, 1999) and the Plant Protection Act of 2000, which mandate their control, and if possible, their eradication. Invasive species are defined as "alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health." Noxious weeds are invasive species that have been designated by rule (i.e. state, county, municipality, etc.) as being noxious, and meet one or more of the following criteria: 1) aggressively invades or is detrimental to economic crops or native plant communities, 2) is poisonous to livestock, 3) is a carrier of detrimental insects, diseases, or parasites, and/or 4) the direct or indirect effect of the presence of this plant is detrimental to natural ecosystems or agricultural areas (CNAP et al., 2000). Noxious weeds are found at the NWTC on some disturbed lands, but these populations are being aggressively managed through NREL's weed management programs. During a 2001 field visit by SAIC staff, the most commonly encountered noxious weeds at NWTC were diffuse knapweed (*Centaurea diffusa*) and Canada thistle (*Breea arvensis*). *Breea arvensis* was previously known as *Cirsium arvense*.

At NWTC, 11 plant species found on the State of Colorado Noxious Weed List were identified (Plantae, 2000). These species are listed in Table 3-7.

Table 3-7. Noxious Weed Species Occurring at the NWTC, Golden, Colorado.

Common Name	Scientific Name
Canada thistle*	*Breea arvensis*
Common mullein	*Verbascum thapsus*
Field bindweed*	*Convolvulus arvensis*
St. Johnswort	*Hypericum perforatum*
Teasel	*Dipsacus fullonum*
Dalmatian toadflax	*Linaria genistifolia var. dalmatica*
Diffuse knapweed*	*Centaurea diffusa*
Hoary cress*	*Cardaria draba*
Houndstongue	*Cynoglossum officinale*
Leafy spurge*	*Euphorbia esula*
Musk thistle*	*Carduus nutans*
Sulphur cinquefoil	*Potentilla recta*

**Found on the top ten priority list for noxious weed control in the State of Colorado.*
Source: Plantae, 2000.

3.8.2 Wetlands

Wetlands are a special type of habitat that are characterized by hydric soils (e.g., dark color, saturated moisture regime, sulfidic [rotten egg smell] odor), dominant vegetation typically adapted for life on hydric soils (i.e., hydrophytes), and by positive indicators of wetland hydrology (e.g., drainage paths, drift lines [flood debris wrapped around plant stems], prolonged soil saturation or inundation). Field efforts to delineate site wetlands has not been undertaken to verify the presence of hydric soils, dominance of hydrophytic vegetation, and characteristic wetland hydrology. The USACE has mapped wetlands along the site's linear drainage features (McKee, 2001). Because the USACE did not attempt to perform wetland delineations on isolated hillside seeps or non-linear surface water features, this EA document refers to the non-linear wetland features as "potential" wetland resources within the NWTC boundary.

These resources include six areas of groundwater seeps. Four of the "potential" wetland resources could more precisely be defined as palustrine (i.e., depressional) emergent wetlands using the Cowardin et al. classification scheme (1979). There are two hillside seep areas that are potential wetlands. There are also two ephemeral drainages with riparian fringe (i.e., streambank) hydrophytic vegetation that have been delineated by USACE, and constitute on-site jurisdictional wetlands. Figure 3-4 depicts the potential and previously delineated wetland resources. Table 3-8 provides designations for individual wetland areas and also provides approximate acreage for these sensitive environments.

Table 3-8. Potential and Previously Delineated Wetlands Occurring at the NWTC, Golden, Colorado

Wetland Type*	Wetland Designation	Area (acres)
Palustrine Emergent Wetlands (Potential)	PE-1 through PE-4 (Figure 3-4)	PE-1 = 0.25 PE-2 = 0.38 PE-3 = 0.28 PE-4 = 0.09
Groundwater Seep Wetlands (Potential)	GS-1 and GS-2(Figure 3-4)	GS-1 = 0.71 GS-2 = 0.30
USACE – Delineated Wetlands	Riparian Fringe (RF-1 and RF-2 on Figure 3-4)	RF-1 = 0.12 RF-2 = 0.07
	Total Acreage	**2.20**

Legend: PE = palustrine emergent; GS = groundwater seep, RF = riparian fringe
*PE is consistent with classification in Cowardin et al. 1979. GS are likely palustrine wetlands types and RF is likely a combination of riverine and palustrine wetland types in Cowardin et al. 1979.

Palustrine Emergent Wetlands

There are four potential palustrine emergent wetlands on the NWTC site constituting approximately one acre of land. The palustrine emergent wetlands PE-1, PE-2, and PE-3 are located in the southwest corner of the site, adjacent to the site's gravel access road. Each of these three potential wetlands are dominated by cattails and are formed in areas of slightly

depressed topography. The fact that they remain wet enough to support cattail growth suggests that they are receiving shallow groundwater discharge at or near the surface, or they are holding precipitation or runoff for long enough to support hydrophytic vegetation. Palustrine emergent wetland PE-4 is located just south of the Dynamometer building at the NWTC. The system features a ponded center ringed by cattails and other hydrophytic vegetation. The pond appeared to be at least 2-3 feet deep during a July 26, 2001 site reconnaissance (SAIC, 2001). This would support the assumption that this site is saturated or inundated for a large portion of the growing season, if not for the entire year.

Groundwater Seep Wetlands

There are two potential groundwater seep wetlands on the property. These systems constitute approximately 1.01 acres of habitat at the NWTC. A vegetation survey by Plantae (2000) identified several obligate wetland species in these systems. Obligate wetland species are those plants found to occur in wetlands more than 99% of the time. Table 3-9 provides a list of these obligate wetland plant species. Several other species of rushes and sedges were identified in groundwater seeps on-site, most of which qualify as facultative wetland species in the *Revision of The National List of Plant Species That Occur in Wetlands* (Reed, 1997). A facultative wetland plant is one that occurs in wetlands between 67 and 99% of the time.

Table 3-9. Obligate Wetland Plant Species Occurring in Groundwater Seep Wetlands at the NWTC, Golden, Colorado

Common Name	Scientific Name
Nebraska sedge	*Carex nebrascensis*
Woolly sedge	*Carex lanuginosa*
Spikerush	*Eleocharis palustris*
Fowl mannagrass	*Glyceria striata*
Wild iris	*Iris missouriensis*
Knotted rush	*Juncus nodosus*
Common rush	*Juncus effusus*
Common cattail	*Typha latifolia*
Narrow-leaved cattail	*Typha angustifolia*

Source: Plantae, 2000.

Groundwater seep wetland GS-1 is a swale feature immediately downstream of the seasonal pond. The swale features hydrophytic vegetation. It is speculated that the swale may be a point of groundwater discharge. It should be stressed that no fieldwork was conducted to document hydric soil or wetland hydrology indicators, thus this area's designation as a "potential" wetland is based on the dominant hydrophytic vegetation alone.

Groundwater seep wetland GS-2 is located just northeast of the parking lot for the main administration building at NWTC. This feature is another ponded area, potentially supported by discharge of shallow groundwater. Cattails and several species of bulrush surround the wetland. The ponded center of the wetland appeared at least 1 to 2 feet deep, and perhaps deeper (SAIC, 2001).

Riparian Fringe Wetlands

The NWTC features two ephemeral drainages that support riparian fringe wetlands. The first of these drainages begins near the center of the site and flows east/northeast through the site. The drainage is designated as wetland RF-1. Wetland RF-1 extends for approximately 0.5 miles (.81 kilometers) across the site's mid-section. The second ephemeral drainage on-site is located on the northeast corner of the property (RF-2). Wetland RF-2 begins on-site, but the majority of this system runs off the site to the northeast. Both of these drainages feature flowing surface water only in response to precipitation events, and were not flowing at the time of SAIC's site reconnaissance in July, 2001. Both drainages have somewhat defined channels and hydrophytic vegetation (primarily rushes, sedges, and grasses) along the fringe of these channels. The USACE has delineated both of these wetland areas and considers them jurisdictional (McKee, 2001).

Regulation and Function

Wetlands may receive jurisdictional status and incur regulation by the USACE if they meet the three criteria of presence of hydric soils, dominant hydrophytic vegetation, and characteristic wetland hydrology listed previously in this section. However, the recent Supreme Court ruling in the matter of Solid Waste Agency of Northern Cook County vs. U.S. Army Corps of Engineers, No. 99-1178 (January 9, 2001), has some bearing on jurisdictional status for all of the potential wetlands at the NWTC site. In the Supreme Court's ruling, the Department of the Army's (DA) jurisdiction over isolated, non-navigable, intrastate waters has been eliminated in cases where the sole nexus to interstate commerce is use of the waters by migratory birds.

The six "potential" wetlands of the NWTC (i.e., the four palustrine emergent wetlands and the two groundwater seep wetlands) are isolated and in non-navigable waters, with doubtful connection to any interstate commerce. For these reasons, it is not likely that these NWTC wetland resources would receive a jurisdictional status if currently reviewed by USACE. Nevertheless, these resources are valuable habitat for wildlife, and they add considerably to the plant biodiversity at NWTC. They may also function to attenuate flood flow, maintain and potentially improve water quality, support the aquatic food web, and retain sediment from runoff over the site.

3.8.3 Rare Plant Species

Two federally-listed threatened plant species, Ute ladies'-tresses orchid (*Spiranthes diluvialis*) and Colorado butterfly plant (*Gaura neomexicana ssp. coloradensis*), could potentially occur at the NWTC. Ute ladies'-tresses was listed as threatened under the Endangered Species Act in 1992 and Colorado butterfly plant was listed as threatened in 2000. Critical habitat has not been designated for either species. Concurrence with the USWFS was requested for the list of threatened and endangered species that are likely to occur at the NWTC (Appendix G).

Ute ladies'-tresses is a perennial orchid with 7 to 32 inch (0.2 to 1 meter) high stems. It has narrow leaves approximately 11 inches long at the base of the stem that become reduced in size going up the stem. The flowers consist of 3 to 15 small white or ivory colored flowers clustered into a spike arrangement at the top of the stem. It typically blooms from late July through August, but blooms have been recorded as early as early July and as late as early October depending on location and climate (50 CFR Part 17, Final rule, February 18, 1992). Colorado butterfly plant is a short-lived, monocarpic (flowering and bearing fruit only once),

perennial herb with one or a few reddish, pubescent stems that are 2 to 3 feet (0.6 to 1 meter) tall. The lower leaves are lance-shaped with smooth or wavy-toothed margins averaging 2 to 6 inches (5 to 15 centimeters) long, while those on the stem are smaller and reduced in number. Flowers are arranged in a branched, elongate inflorescence above the leaves. Only a few flowers are open at any one time and these are located below the rounded buds and above the mature fruits. Flowering begins in late June or early July and continues until the first hard freeze, typically late September to early October (Fertig, 2000a). Individual flowers are 0.25 to 0.5 inches (0.6 to 1.2 centimeters) long with four reddish sepals and four white petals that turn pink or red with age. The hard, nutlike fruits are 4-angled and sessile (stalkless and attached directly at the base). Non-flowering plants consist of a stemless, basal rosette of oblong, hairless leaves 1 to 7 inches (2.5 to 17.7 centimeters) long (Federal Register: March 24, 1998, Volume 63, Number 56, Proposed Rules, pp. 14060-14065).

Both Ute ladies'-tresses and the Colorado butterfly plant occur in similar habitat, namely riparian and wetland areas with vegetation that is relatively open. Ute ladies'-tresses are endemic to moist soils in mesic or wet meadows near springs, lakes, or perennial streams between 1,800 and 6,000 feet (545 to 1818 meters) elevation. Ute ladies'-tresses occur primarily in areas where the vegetation is relatively open and not overly dense, overgrown, or overgrazed (50 CFR Part 17, Final rule, February 18, 1992). Populations have been documented from alkaline sedge meadows dominated by water sedge (*Carex aquatilis),* clustered field sedge (*C. praegracilis),* and wooly sedge (*C. lanuginose)*; riverine floodplains with beaked sedge (*Eleocharis rostellata),* silverberry wolfwillow/redtop (*Eleagnus commutata/Agrostis stonlonifera),* sandbar willow/coyote willow *(Salix exigua/Agrostis stolonifera),* and horsetail scouring rush (*Equisetum variegatum)* cover types; flooded alkaline meadows adjacent to yellow Ponderosa Pine/Douglas Fir (*Pinus ponderosa/Pseudotsuga menziesii)* woodlands and sagebrush steppe; and from streamside floodplains and meadows on alluvium (Fertig, 2000b).

The Colorado butterfly plant occurs on subirrigated, alluvial soils on level or slightly sloping floodplains and drainage bottoms at elevations of 5,000-6,400 feet (1515-1939 meters). Colonies are often found in low depressions or along bends in wide, active, meandering stream channels a short distance upslope of the actual channel. The plant requires early to mid-succession riparian habitats. It commonly occurs in communities dominated by silverberry wolfwillow/redtop (*Agrostis stolonifera)* and Kentucky Bluegrass (*Poa pratensis)* on wetter sites and American licorice (*Glycyrrhiza lepidota)*, flodman's thistle (*Cirsium flodmanii)*, curlycup gumweed (*Grindelia squarrosa)*, and *Hippochaete laevigata* on drier sites. These areas are usually intermediate in moisture between wet, streamside communities dominated by sedges, rushes, and cattails, and dry, upland shortgrass prairie. Typical habitat is relatively open without dense or overgrown vegetation. Sandbar willow (*Salix exigua)* and *Breea arvensis* may become dominant in areas that are not periodically flooded or otherwise disturbed.

According to the Colorado Natural Heritage Program, Ute ladies-tresses is known to occur in Jefferson County and neighboring Boulder County; the Colorado butterfly plant is not known to occur in Jefferson County, but has been found in Boulder County (CNHP, 2001). A survey was conducted at the NWTC on July 24, 2001 for both species in appropriate habitat. Appropriate habitat included the four plant communities that make up the "Seasonal Wetland/Ephemeral Hydric Soils" habitat as described in Plantae, 2000; namely cattail seeps, ephemeral drainages, hillside seeps, and seasonal pond. Survey methods for Ute ladies'-tresses followed USFWS "Interim Survey Requirements for *Spiranthes diluvialis*" (USFWS, 1992); no similar requirements are available for the Colorado butterfly plant. The survey date falls within the required survey period for Ute ladies'-tresses (July 20 to August 31) and within the flowering period for the

Colorado butterfly plant. Per the survey requirements, the USFWS was contacted prior to the survey to inquire as to whether other known populations were flowering late or early for the year so that the survey date could be adjusted if necessary (J. McKee, USFWS, pers. comm., July, 2001). The USFWS determined the survey date was appropriate and that Ute ladies'-tresses were likely to be in bloom, and therefore identifiable, due to adequate moisture during June and July 2001. The survey was submitted to the USFWS for approval on April 8, 2002, as required by the Interim Survey Requirements for *Spiranthes diluvialis*.

No Ute ladies'-tresses or Colorado butterfly plants were found during the 2001 survey. The cattail seeps did not provide appropriate habitat for either Ute ladies'-tresses or Colorado butterfly plant due to dense, overgrown vegetation. The ephemeral drainages, comprised of a mix of sedges, rushes, grasses, and forbs, provided marginal habitat for Ute ladies'-tresses, but lacked habitat features such as a perennial stream channel and associated riparian vegetation for the Colorado butterfly plant. The vegetation at the hillside seep in the northeast corner of the NWTC, dominated by prairie cordgrass (*Spartina pectinata), Glycyrrhiza lepidota,* and patches of common cattail (*Typha latifolia)* and rush (*Juncus arcticus)*, was too dense to provide habitat for either species. The seasonal pond did not provide habitat for the Colorado butterfly plant and does not appear to hold water long enough to create moist or mesic conditions throughout the summer, preferred by Ute ladies'-tresses. The dominants observed in the seasonal pond during the July 2001 survey included *Critesion jubatum ,* Canada bluegrass *(Poa compressa),* and sow thistle (*Sonchus arvensis)*; these species are generally indicative of dry, upland conditions.

In addition to the 2001 survey, previous surveys conducted at the NWTC and at the adjacent RFETS have found no Ute ladies'-tresses or Colorado butterfly plant. During the 2000 survey period, a survey for Ute ladies'-tresses was conducted as part of a larger vegetation survey at the NWTC in the "Seasonal Wetland/Ephemeral Hydric Soils" habitat, but none were found (Plantae, Consulting Services 2000). This survey did not specifically include the Colorado butterfly plant, but this species was not included on the plant species list generated from the sitewide vegetation survey conducted at the NWTC during 1999 and 2000 (Plantae, Consulting Services 2000). Vegetation surveys have been ongoing at the RFETS for several years and no Ute ladies'-tresses or Colorado butterfly plants have been found at the 6,300-acre RFETS located to the south and east of the NWTC (Exponent, 1999; NREL, 1996).

3.8.4 Wildlife

Wildlife habitat at the NWTC is primarily flat, xeric mixed grassland. The NWTC also includes a relatively small patch of mesic mixed grassland habitat (historically tallgrass prairie with big bluestem and other tallgrasses), a ponderosa pine woodland, a small upland shrubland site, six groundwater seep wetlands, and two ephemeral drainages. Each of these habitat types contains characteristic fauna. Surface water resources available to the wildlife at NWTC are very limited to the aforementioned groundwater seep areas.

The DOE prepared a biological characterization inventory for the adjoining RFETS, including the NWTC, in 1992. Much of the information for this wildlife section comes from data contained in that report, and is presented in Table 3-10. Wildlife issues identified during the scoping process included: impacts to the federally threatened Preble's meadow jumping mouse (Preble's) and its habitat, and bird and bat strikes from turbine blades. These species are discussed in more detail in subsections following Table 3-10.

Table 3-10. Wildlife Present at the NWTC, Golden, Colorado

Small Mammals	
Deer mice	*Peromyscus maniculatus*
Prairie vole	*Microtus ochrogaster*
Thirteen-lined ground squirrel	*Spermophilus tridecemlineatus*
Mexican woodrat	*Neotoma mexicana*
Medium Mammals	
Desert cottontail	*Sylvilagus auduboni*
White-tailed jackrabbit	*Lepus townsendii*
Black-tailed jackrabbit	*Lepus californicus*
Large Mammals	
Coyote	*Canis latrans*
Mule deer	*Odocoileus hemionus*
Black bear	*Ursus americanus*
Mountain lion	*Felis concolor*
Reptiles and Amphibians	
Prairie rattlesnake	*Crotalus viridis*
Short-horned lizard	*Phrynosoma hernandesi.*
Bullsnake	*Pituophis catenifer*
Plains garter snake	*Thamnophis radix*
Racer	*Coluber constrictor*
Northern leopard frog	*Rana pipiens*
Turtle (possibly painted turtle)	*Chrysemys picta*
Tiger salamander	*Ambystoma tigrinum*

Concurrence from the USFWS was requested for the list of threatened and endangered species that are likely to occur in the NWTC in accordance with the informal consultation process outlined in Section 7 of the ESA (Appendix G).

Preble's Meadow Jumping Mouse

Preble's is a relatively small mouse with large hind feet and a long sparsely haired tail that is usually longer than the body [total length is generally between 7.5-10 in (187-255 mm) with the tail approximately 4-5 in (108-136 mm)] (Fitzgerald et al., 1994; Clark and Stromberg, 1987). The dorsal (back) color is yellowish brown and there is usually an indistinct dark mid-dorsal band running the length of the body. The sides are paler than the dorsum (back) and the ventral (belly) is generally white.

Preble's was listed as threatened in May 1998 (USFWS 1998a). The decline of Preble's is thought to be primarily due to habitat loss, degradation, and fragmentation (USFWS, 1998a). Other factors potentially affecting Preble's include pesticide and herbicide use, livestock grazing practices, urban development, and inadequacy of existing regulatory measures (USFWS, 1998a). Historical loss of riparian wetlands may be the largest cause of decline for this species.

Preble's occur only in Colorado and Wyoming. Historically, they occurred from the Front Range of Colorado east to the South Platte River and from Colorado Springs north to the North Platte River in Wyoming. They continue to occur over most of this range, but habitat loss and degradation has resulted in smaller isolated populations. The USFWS indicates potential

habitat for Preble's exists in Colorado below 7,600 feet (2,303 meters) elevation along the western boundary (Front Range) to a line drawn north/south through Fort Morgan along the eastern boundary and from El Paso County (Colorado Springs) north to the Wyoming Border (USFWS, 1999a).

Preble's appear to have specific habitat requirements that relate to riparian habitats along perennial streams. Preble's are most common in rank, lush vegetation along watercourses and in herbaceous understories of wooded riparian areas (Armstrong et al., 1997a, Fitzgerald et al., 1994). Generally, they are found where dense undergrowth consisting of grasses and forbs occur in wet meadows and riparian corridors and where tall shrubs or trees provide overstory cover (USFWS, 1998b; Armstrong et al., 1997a, 1997b). Most records from Colorado are from tallgrass habitat near water (Fitzgerald et al., 1994). Preble's hibernate in dry soil upland sites adjacent to the riparian habitats they occupy during the summer (Clark and Stromberg, 1987; Whitaker Jr., 1972). Dense vegetative cover is important to maintain populations of this species; therefore, overgrazing by domestic livestock in riparian zones is thought to be a primary cause of the decline of this species.

The headwaters of two ephemeral drainages occur on the NWTC (Figure 3-4). The drainage on the east side of NWTC flows east toward Rock Creek on the RFETS. The drainage on the north side of NWTC flows northwest to Coal Creek on private lands near the junction of Highways 128 and 93. Habitat within these drainages is generally considered unsuitable for Preble's because both drainages are ephemeral with only isolated patches of open water, which likely dry up in most years. While the drainages contain some hydrophytic vegetation, the vegetation structure lacks an extensive overstory component (e.g., willow), which is believed essential to suitable Preble's habitat. The lack of perennial water and complex vegetation structure (e.g. overstory) likely precludes use by Preble's. However, a single Preble's was captured in the off-site drainage in August 1997 (ETS, 1997) near the alignment of Option 1 of the proposed pipeline. As a result, the USFWS considers this drainage occupied habitat (Plage, 2001)

Birds

The following discussion is based on RFETS avian survey data, as well as previously collected on-site data. Avian species composition and abundance data have been collected at the RFETS since 1991. Details about this data are presented in the following discussion.

Since 1991, 194 species of birds have been documented, 74 of which are either confirmed or suspected breeders.

A total of 103 species of neotropical migrants have been identified on RFETS, of which 45 species are confirmed or suspected breeders. Neotropical migrants breed in the United States and Canada, but spend their winters in Central and South America. Due to loss of habitat and other mortality factors, many species of neotropical migrants are showing dramatic population declines.

Thirty-four species of waterfowl have been observed at RFETS, 14 of which are suspected breeders. Most waterfowl on the RFETS occur on large impoundments, but a few are also sighted on creeks, small pools, and grasslands. The most abundant species are Canada goose, mallard, blue-winged teal, ring-necked duck, American coot, and green-winged teal. The most common wader is the great blue heron. Waterfowl observations documented during

inventories of the NWTC were limited to two species (Canada goose and mallard) that were flying over the site. Great blue herons were also observed flying over the site, but no waterfowl or waterbirds were documented on the site itself. There are no ponds or other open water habitats on the NWTC that would attract waterfowl or other waterbirds (NREL, 1996); however, small ponds associated with an adjacent gravel pit operation may attract waterfowl and other waterbirds.

On an annual basis, the most abundant songbirds on RFETS are red-winged blackbird, European starling, house finch, western meadowlark, vesper sparrow, song sparrow, barn swallow and cliff swallow; however, seasonal differences in abundance occur (Kaiser-Hill, 1997a, 1998, 1999, 2000). Songbirds identified on the NWTC, primarily in the ponderosa pine woodlands, were green-tailed towhee, song sparrow, American robin, and dark-eyed junco (NREL EA, 1996).

The three most abundant raptors and the only raptor species that occupy the site year round are great horned owl, red-tailed hawk, and American kestrel. Swainson's hawks, turkey vultures, and ferruginous hawks are observed primarily in the spring and summer, while northern harrier, golden eagle, rough-legged hawk, prairie falcon and bald eagle are observed mostly in the fall and winter. Habitats that receive the highest use by raptors include shrublands near Rock Creek, riparian corridors, and around lakes and ponds. Raptor species that have been documented breeding on the RFETS include great horned owl, red-tailed hawk, Swainson's hawk, and American kestrel.

Several federal and/or State of Colorado avian species of concern have also been documented at RFETS. The bald eagle (federally threatened) and peregrine falcon (state endangered) have been occasional transients across the site. In 1996, bald eagles nested at Stanley Lake located approximately 3.8 miles (6 kilometers) from RFETS. In addition, two active peregrine falcon nests were reported in the vicinity. One falcon nest was reported at Eldorado Canyon, approximately 5 miles (8 kilometers) west of the NWTC, and another in the Flatirons, approximately 6.9 miles (11 kilometers) away (Monahan, 1996). Other state and/or federal species of concern documented at the site include American white pelican, long-billed curlew, white-faced ibis, burrowing owl, and loggerhead shrike (Kaiser-Hil, 1997a, 1997b, 1998, 1999, 2000). Most of these species are observed only as occasional transients; however, loggerhead shrikes are suspected to nest in appropriate shrubland habitats on the RFETS. Twenty species of birds on the Colorado State watch-list have also been documented on RFETS (Kaiser-Hill, 1997a, 1998, 1999, 2000). No nest sites for avian species of concern are currently known to exist on the NWTC site, but they are expected to be present in the vicinity.

In 1994 and 1995, an extensive study of raptor use of the NWTC was conducted to determine raptor species composition, use, flight height, and potential for collision mortality at the NWTC (Monahan 1996). This study was undertaken primarily because the wind resources that make NWTC attractive for wind energy research are also likely to attract a diverse community of raptors (Monahan, 1996).

Raptor use of the NWTC was studied for a 17-month period starting in February of 1994. At NWTC, 16 of the 18 species of raptor known to occur along the Front Range of Colorado were documented during 786 hours of observation from February 23, 1994 to June 30, 1995. Resident raptor species that used NWTC on a regular basis included red-tailed hawk, prairie falcon, American kestrel, and rough-legged hawk. All four of these species regularly perched on structures within the NWTC such as meteorological towers. Both bald and golden eagles were

seen regularly at certain seasons, but were only observed perching on one occasion each. The remaining 11 species were seen infrequently and rarely or never landed on the NWTC (see Table 3-11).

Table 3-11. Raptor Species and Abundance at the NWTC, Golden, CO

Species	Status	
	Winter	Summer
Bald Eagle	Common	Absent
Golden Eagle	Common	Uncommon
Osprey	Rare migrant	
Turkey Vulture	Absent	Common
Northern Harrier	Rare migrant	
Sharp-shinned Hawk	Rare migrant	
Cooper's Hawk	Rare migrant	
Northern Goshawk	Rare migrant	
Broad-winged Hawk	Rare migrant	
Red-tailed Hawk	Common	Common
Rough-legged Hawk	Common	Absent
American Kestrel	Very rare	Common
Merlin	Very rare migrant	
Prairie Falcon	Common	Common
Peregrine Falcon	Absent	Very rare

Source: Monahan 1996

The estimated minimum number of individuals that used (i.e., perched on) NWTC trees or structures over the study period was estimated to be two rough-legged hawks, six American kestrels, four red-tailed hawks, and two prairie falcons. All four resident species foraged on NWTC. The number of attempted prey strikes observed over the study was 136 by American kestrel, nine by red-tailed hawk, seven by rough-legged hawk, and 10 by prairie falcon. The only documented raptor nest at NWTC during the study was an American kestrel nest present in 1994.

Over the 786 hours of observation, 124 eagle sightings were made, comprised of 39 bald eagles, 67 golden eagles, and 18 unidentified eagles. Most of the eagles were seen between 2 p.m. and 6 p.m. All of the bald eagles were seen from 20 October to 26 February, indicating use of the NWTC was limited primarily to wintering birds, despite the presence of an active bald eagle nest 3.8 miles (6 kilometers) away from the NWTC. The flight paths of eagles seen passing by the NWTC in late afternoon were towards roost areas in Eldorado Canyon. As many as 10 bald and four golden eagles may have roosted in Eldorado Canyon during the winter that the study was conducted. Most eagles showed direct, sustained flight through the area and most of the bald eagles passed by north of the NWTC. After the Monahan study was completed, plague and a new development along Rock Creek nearly eliminated prairie dogs in the area. The prairie dog towns were foraging areas for wintering bald eagles. In 2001, there were no bald eagles wintering in Eldorado Canyon. For these, and possibly other reasons, the number of eagles that currently traverse the NWTC in 2002 may be lower than when the Monahan study was conducted (Marsha Murdock, Kaiser-Hill, 2001).

During spring migration in 1994 and 1995, 290 raptors of 14 species were recorded on the NWTC during 140 hours of observation. Most of the migrants were turkey vultures (56%) and American kestrels (29%). Large falcons comprised 2.5%, and accipiters and buteos each comprised 5% of the migrant birds (Monahan, 1996).

During spring counts of migrant raptors by the Colorado Hawkwatch Program at a site (6.3 miles (10-kilometers) due south of the NWTC, 2,000 to 3,000 raptors were recorded per spring migration. The number of migrant raptors seen passing by in the vicinity of the NWTC was only 12% of the number detected at the Hawkwatch site. The much lower number of migrant raptors passing over the NWTC is likely due to its geography. The NWTC is about twice as far from the foothills as is the Hawkwatch site. In addition, the Hawkwatch site is higher in elevation and positioned along a sharply defined ridge, whereas the NWTC is on a relatively flat bench. If raptors track the edge of the foothills, then their flight paths would occur primarily from 1.9 miles to 3.8 miles (3 km to 6 kilometers) west of the NWTC (Monahan, 1996). Other studies have shown that higher raptor use occurs near rim edges, canyons and other areas of rough topography than over areas with flat topography (Johnson et al., 2000a; Orloff and Flannery, 1992).

Of 15 bald eagles observed flying over the NWTC, flight heights ranged from 33 feet to 394 feet (10 m to 120 meters) and averaged 184 feet (56 meters). For 14 bald eagles flying adjacent to the site, flight height ranged from 10 feet to 164 feet (3 m to 50 meters and averaged 92 feet (28 meters). Six of the 15 bald eagles that traversed over the NWTC were flying less than the height of the tallest wind turbine present at the time (98 feet (30 meters)), and 13 of the 15 eagles were flying at or below the height of the tallest met tower present on the site (262 feet (80 meters)). For 13 golden eagles observed flying over the NWTC, flight height ranged from 33 to 295 feet (10 meters to 90 meters), and averaged 131 feet (40 meters). For 23 golden eagles observed flying adjacent to the NWTC, flight heights ranged from 33 feet to 525 feet (10 to 160 meters), and averaged 223 feet (68 meters). Six of the 13 golden eagles observed flying over the NWTC were flying at or below the tallest turbine height of 98 feet (30 meters), and 12 of the 13 were flying at or below the tallest met tower height of 262 feet (80 meters).

Of the two most common migrants, only 14 of 149 turkey vultures flew directly over the NWTC. Of these 14, only three were flying below the height of the tallest met tower (262 feet (80 meters)). For those turkey vultures flying near the NWTC, only 9% were flying $\leq$ 262 feet (80 meters). Of the American kestrels observed migrating, 81% were flying $\leq$ 262 feet (80 meters) in height. Of 13 buteos observed during migration (8 red-tailed hawks, 2 broad-winged hawks, 2 Swainson's hawks, and 1 rough-legged hawk), only two were observed flying $\leq$ 262 feet (80 meters). Six of the 14 migrant accipiters observed during the study were flying $\leq$ 262 feet (80 meters). All four large falcons (prairie or peregrine) that were observed were flying $\geq$ 262 feet (80 meters). One merlin flew over at a height of 33 feet (10 meters), and two of four migrating osprey were flying $\leq$ 262 feet (80 meters). These data indicate that many raptors traverse the NWTC at flight heights making them susceptible to collisions with turbines or meterological towers. However, flight height is only one of numerous factors that determine the potential for avian mortality. Other factors include avian abundance and composition, presence of migration corridors, geographic area, landscape features, prey abundance and wind plant features (Nelson and Curry, 1995; Orloff, 1992).

Starting on May 30, 2001, standardized plot surveys have been conducted to survey songbirds and raptors on the NWTC and adjacent, undeveloped areas. The study is funded through July of 2002. As of July 18, 2001, 15 species of songbird were recorded on the NWTC. The five

most common species were vesper sparrow, western meadowlark, European starling, black-billed magpie, and cliff swallow (Armstrong et al,. 2001). Six species of large birds were also observed on the NWTC. American kestrel was most abundant, followed by great blue heron, red-tailed hawk, double-crested cormorant, peregrine falcon, and prairie falcon. The authors believed that great blue herons were using the NWTC as a flight corridor. Some differences were noted in avian composition on the NWTC and adjacent areas. Western meadlowlarks were less common on the NWTC, whereas common grackles and Say's phoebes were more common. Species richness on the NWTC (2.29 species per survey) was also lower than surrounding areas (2.80 species per survey). No statistically significant difference was noted in raptor use or species richness on the NWTC and surrounding areas. However, the authors believed that some raptors such as American kestrels and red-tailed hawks used the NWTC more than surrounding areas due to the availability of perch sites (e.g., meteorological towers, turbines) (Armstrong et al., 2001).

Although no formal carcass searches were being conducted, two fatalities were collected at NWTC over the last four years, including a rough-legged hawk and a banded homing pigeon. Starting on May 29, 2001, NREL has been conducting systematic searches of turbines and meteorological towers on the NWTC to document avian mortality. The study is funded through July 2002. As of November 15, 2001, three avian fatalities have been found, including a yellow-rumped warbler found under a guy wire supporting a met tower, an American kestrel under a small turbine, and a black-billed magpie under a turbine with a lattice base (Armstrong et al., 2001).

To place these fatalities in perspective, it has been estimated that from 100 million to well over 1 billion birds are killed annually in the U.S. due to collisions with human-made obstacles, including vehicles, aircraft, buildings and windows, powerlines, communication towers, smokestacks, and other structures (Erickson et al., 2001; Klem, 1990; Manville, 2000). Although generally considered environmentally friendly, windpower development has been associated with the death of birds colliding with turbines and other windplant structures.

Based on a summary of windpower/avian interaction studies conducted in the U.S. and an industry projection of about 15,000 operational wind turbines in the U.S. by the end of 2001, Erickson et al. (2001) estimated that approximately 33,000 birds may be killed on an annual basis by colliding with wind turbines in the United States. Across the U.S., most collision fatalities (34.3%) are raptors, 31.5% are passerines, 14.0% are non-protected species (i.e., rock dove, European starling, house sparrow), 9.1% are owls, and the remaining 11.1% are other groups (e.g., waterbirds, waterfowl, shorebirds). Approximately 2.6% of fatalities within and 34% of fatalities outside California are considered nocturnal migrant collision victims (Erickson et al., 2001). At the current level of development, wind turbines are estimated to constitute 0.01% to 0.02% of the avian collision fatalities in the U.S.

Based on current site conditions, collision mortality to the four resident raptor species at NWTC should have no long-term or substantial population impacts because only two to six individuals of each species appear to use the NWTC (Monahan, 1996). Of those raptor species resident in the vicinity of the NWTC, turkey vultures have a low probability of collision because they were rarely observed on the NWTC and those few resident birds that were observed always flew higher than the structures. Although two peregrine falcon nests occur within 11 km of the NWTC, only one peregrine falcon was observed during the raptor study at NWTC, implying that probability of collision for this species is minimal. Although golden eagles likely nest in several locations within 30 km of the NWTC, this species has a low probability of collision because the

NWTC lacks a suitable prey base for eagles. Of all raptor species documented at the NWTC, American kestrels appear to be the only species abundant enough during migration to have an appreciable probability of collision mortality at the NWTC (Monahan, 1996). American kestrels and other migratory birds are protected under the Migratory Bird Treaty Act.

Because of its research nature, the NWTC has numerous meteorological towers not normally associated with commercial wind power developments. Thin guy wires used to support the meteorological towers are hard for birds to detect, especially at night. Some research has shown guyed meteorological towers may be more hazardous than wind turbines. At a windplant in Carbon County, Wyoming, avian collision mortality at 200-foot tall guyed meteorological towers was estimated to be 7.5 per year, compared to 1.8 collision fatalities per year for 200 foot tall wind turbines (Johnson et al., 2001).

Avian collision mortality associated with windpower development has not been shown to result in population declines of any species with the possible exception of golden eagles and burrowing owls at Altamont, California, where over 5,000 turbines exist in the Wind Resource Area (WRA). Avian collision mortality at other regional windplants (i.e., Ponnequin site in Weld County, Colorado, Foote Creek Rim Windplant in Carbon County, Wyoming) is relatively low (Kerlinger and Curry 2000; Kerlinger et al., 2000; Johnson et al., 2000b), and no population consequences for any species have been suspected. With the exception of Altamont, the number of avian collision fatalities have not been extensive enough at any commercial windplant in the U.S. to warrant further population studies designed to measure impacts.

The NWTC site has fewer turbines than most commercial windplants, and the research turbines are running far less frequently than windpower plant turbines. Despite the large number of guyed structures, mortality data collected to date do not indicate extensive avian mortality at the NWTC, and the species found to date are common (Armstrong et al., 2001). Therefore, it is logical to assume that few, if any, impacts to avian populations are occurring at the NWTC under current operational conditions. Current survey data support this conclusion. A similar conclusion was reached in a letter from the U.S. Fish and Wildlife Service to NREL prepared in relation to 1996 Site-Wide EA for the NWTC (Carlson, 1995).

Bats

Based on range maps and habitat descriptions in Fitzgerald et al. (1994), up to 10 species of bats could potentially be found on the NWTC (see Table 3-12).

NREL is currently conducting a study to evaluate bat use of the NWTC and adjacent areas within 2.5 miles (4 kilometers) of the site. The study is funded through July 2002. Bat carcasses near turbines have been searched for since late May 2001. Data collection to determine bat species composition and use of the area began in June 2001. Initial trapping surveys with mistnets have documented the presence of fringed myotis and big brown bats near the site. Bat species documented on the NWTC itself using bat detectors in August and September 2001 included hoary bat, silver-haired bat, Mexican freetailed bat, long-legged myotis, small-footed myotis, and little brown myotis. Bats have been documented foraging within wooded areas on the west side of the NWTC during the summer months. Many of the bats that use the NWTC likely roost in rock outcroppings located on open space west of the NWTC. Several bats have been observed on and near the NWTC foraging at heights similar to those occupied by turbine blades (Piaggo, 2001). No bat mortalities have been found at the site.

Table 3-12. Habitat of Bat Species Potentially Occurring on or Near the NWTC, Golden, Colorado

Species	Habitat in Colorado
Western Small-footed Myotis (*Myotis ciliolabrum*)	Broken terrain associated with canyons and foothills, most commonly in areas with tree or shrub cover.
Long-legged Myotis (*Myotis evotis*)	Ponderosa pine forest at elevations of 6,000 to 9,000 feet.
Little Brown Myotis (*Myotis lucifugus*)	Wooded areas from 5,000 to 11,000 feet.
Fringed Myotis (*Myotis thysanodes*)	Ponderosa pine woodlands and shrublands at elevations less than 7500 feet.
Long-legged Myotis (*Myotis volans*)	Ponderosa pine and pinyon-juniper woodlands, montane forests and shrublands up to 12,369 feet.
Red Bat (*Lasiurus borealis*)	Wooded riparian areas and deciduous trees associated with towns and cities. Migrant through Colorado.
Hoary Bat (*Lasiurus cinereus*)	Ponderosa pine and deciduous woodlands less than 10,000 feet elevation. Migrant through Colorado.
Silver-haired Bat (*Lasionycteris noctivagans*)	Forest edges, streams, and ponds from 4500 to 9500 feet elevation. Migrant through Colorado.
Big Brown Bat (*Eptesicus fuscus*)	All habitats below 10,000 feet elevation.
Townsend's Big-eared Bat (*Plecotus townsendii*)	Shrublands, pinyon juniper, open montane forests less than 9500 feet in elevation.

Source: Fitzgerald et al. 1994

Bat populations associated with the NWTC site are important because they can be injured or killed by wind turbines and guy wires. Bat collision mortality has been recently documented at some wind plants. Previous studies have documented bats colliding with other man-made structures, including buildings, lighthouses, and television towers (Van Gelder, 1956; Crawford and Baker, 1981). Most windplants have not documented any bat mortality and only small numbers of bat mortalities have been reported at other facilities (e.g., Erickson et al., 2000; Howell, 1997; Howell and Didonato, 1991; Orloff and Flannery, 1992; Anderson et al., 2000; Thelander and Rugge, 2000; P. Kerlinger Pers. Commun., March 2001). However, large numbers of dead bats have been found at some windplants, including 184 over a 2-year period at the 354-turbine Buffalo Ridge, Minnesota windplant (Johnson et al., 2000b), 35 over a 1-year period at a 31-turbine windfarm in Wisconsin (Steve Ugoretz, Wisconsin Department of Natural Resources, pers. commun., August 2000), and 85 over a 2-year period at a 69-turbine windfarm in Wyoming (Johnson et al., 2001). Most bat fatalities found at wind plants have been tree bats, with hoary, red and silver-haired bats being the most prevalent fatalities.

3.9 CULTURAL RESOURCES

Cultural resources are defined as any prehistoric or historic district, site, or building, structure, or object considered important to a culture, subculture, or community for scientific, traditional, religious or any other reason. Cultural resources can be divided into three major categories: